**Cytology**

**Key Terms:**

Cytology - the study of the structure and function of cells

Cytoplasm - the area of space contained by the cell membrane but outside of the nucleus. The cytoplasm contains the organelles and the   cytosol.

Organelle - tiny structures within the cytoplasm each with its own specific job.

Cytosol - the fluid portion of the cytoplasm.

**Cell Components**

1. **The Nucleus:**

Cell Type:

- Found in all cells except Prokaryotes (bacteria).

Description:

- Membrane bound

- Consists of a nucleolus, nuclear pores, nucleoplasm, and a nuclear membrane

Function:

- Contains and protects the cell's genetic information DNA (Deoxyribonucleic acid).

- Control center of the cell.

**The Parts of the Nucleus**

Nucleolus (Nucleoli) - site of ribosome formation.

Nuclear Membrane/Envelop - membrane surrounding the nucleus.

Nuclear Pores - controls what can enter or leave the nucleus.

The Nucleoplasm – a highly viscous liquid that contains dissolved enzymes and surrounds the nucleolus and chromatin. It is surrounded by the nuclear membrane. Similar in function to the cytoplasm of the cell.

DNA

- The Human Genome consists of about 30,000 Genes.

- **Genes** - a unit of heredity found on a stretch of DNA that  codes for a particular function.

**- Chromatin** - a complex of nucleic acids (DNA or RNA) and proteins (histones) which   condense to form chromosomes   during cell division.

- DNA is composed of Nucleotides.

Each nucleotide is made of the following

 - a phosphate group

 - a pentose sugar

 - a nitrogen base

There are five different types of nitrogen bases.

 - Adenine - Thymine

 - Cytosine - Guanine

 - Uracil (seen in RNA as a replacement for Thymine)

When two nucleotide chains connect together they form a Double Helix. When nucleotides join together a covalent bond (phosphodiester bond) created between the 5' end of the phosphate group of one nucleotide and the 3' end of the OH group (found on the sugar) of the other nucleotide.

Each strand of DNA has a backbone of phosphate - sugar - phosphate - sugar ... The strands of DNA run antiparallel. The 5' end of one strand must be able to pair with the 3' end of the other. The strands are said to be complementary. If one strand of DNA has a sequence of

5'-ATGGCT-3' the other strand must have the sequence 3'-TACCGA-5'.

**2. Ribosomes**

- every cell contains thousands

- assembled in the nucleus and consist of large and small subunits

- found in Cytoplasm and associated with the Rough Endoplasmic Reticulum

- Involved in protein synthesis

- Proteins are long chains of amino acids that make up 75% of a cell's weight.

**The Role of Proteins**

1) Are the main structural component of tissues.

2) Act as Hormones - chemical messengers.

3) Act as Enzymes - controlling chemical reactions that occur within your cells.

**3. Smooth and Rough Endoplasmic Reticulum**

- tubular canals continuous with the nuclear membrane that are used for protein and lipid formation.

**4. Golgi Apparatus**

- "Post Office of the Cell", it gets the proteins and lipids from the ER's and sends them to where they need to go.

**-** Specifically the Golgi Apparatus is involved with sorting, addressing, and packaging proteins into membrane bound vesicles called Lysosomes.

**5. Lysosomes**

- membranous vesicles containing digestive enzymes.

- involved in intracellular digestion and transportation.

**6. Vacuole**

- Storage location for the cell.

- There are two general types:

 - Food Vacuoles - store food particles

 - Water Vacuoles - store water and are more prominent in plant cells

**7. Mitochondrion**

- The Mitochondria (plural) is known as the Power Plant of the cell because it is involved in the breakdown of glucose to create energy.

**Mitochondrion have their own DNA!**

- Scientists have been using the mitochondria DNA to trace hereditary lines through history. Mitochondrion DNA is passed down from mother to child.

- Scientists believe that the first Eukaryotic cell may have been created by a mitochondria cell being engulfed by another cell.

**The Structure of the Mitochondrion**

- The mitochondria is bound by a double layer membrane. The outer membrane is smooth   
and the inner membrane is folded. These folds are called **Cristae**.

**The Mitochondria and Cellular Respiration**

- The Mitochondrion creates energy through the process of Cellular Respiration. The Cristae are responsible for increasing the productivity of Cellular Respiration by increasing the amount   
of surface area available for the process.

- Energy is created in the form of ATP (adenosine triphosphate) through the process of Cellular Respiration:   **C6H12O6 + 6O2 + enzyme ⇒ 6CO2 + 6H2O + Energy**

 36 ATP molecules are created with the breakdown of 1 glucose molecule.

- Cells such as the liver that use a large amount of energy have a high concentration of mitochondria.

Cellular Respiration:

Glycolysis  2 ATP

Kreb's Cycle 2 ATP

Electron transport  32 ATP

**Total = 36 ATP**

**Anaerobic Respiration**

- Mammals generally resort to anaerobic respiration when a quick supply of energy is required.

- The process involves the breakdown of glucose without the use of Oxygen.

C6H12O6 ⇒2C3H6O3 + E

- Only 2 ATP molecules are produced in this process.

- One of the byproducts however in humans is the production of lactic acid. This is what causes your muscles to be sore after exercise.

**8. Chloroplasts**

- Contain the green pigment chlorophyll.

- Involved in the process of photosynthesis. Photosynthesis converts sunlight energy into chemical energy (glucose).

6CO2 + 6H2O ⇒ C6H12O6 + 6O2

- The stroma is the area of the chloroplast in which chemical reactions occur.

- Each Thylakoid has chlorophyll on its surface. A stack of thylakoid is called a granum.

- The granum are held together by the stromal lamellae

**9. The Cytoskeleton**

- The supporting structures that give eukaryotic cells their shape.

**-** The cytoskeleton is a network of protein filaments. The primary protein filaments composing the cytoskeleton are:

 - microfilaments

 - microtubules

**Microfilaments:**

 - are made from threadlike structures called actin.

 - serve two functions:

 1) provides a flexible framework to support the cell.

 2) assemble and disassemble to allow for cytoplasmic movement.

 Ex. Amoebas crawling along a surface.

**Microtubules:**

 - are hollow structures made up of proteins called tubulins

 - are the primary components of centrioles, cilia, and flagellum

10. Centriole

- Occur in pairs.

**-** Produce spindles to attach to chromosomes and pull them apart during cell division.

**-** Have a 9 + 0 pattern of microtubule triplets (9 sets of microtubules arranged in a ring with no microtubules in the middle)

**11. Flagella and Cilia**

- Flexible projections enclosed in cell membrane and extends outward from the cell. Both the flagella and the cilia are responsible for the movement of the cell.

- Cilia are short cylindrical projections that produce a wave - like motion.

- Flagella are long projections that produce a whip-like motion.

**12. Cell Wall**

- Rigid structure made of cellulose that functions to protect the cell and to help the cell maintain its shape.

- Humans have a skeleton to provide structure, organisms such as plants have a cell wall. This is why trees can grow so tall.

**-** The cell wall surrounds the cell membrane and helps prevent the excessive uptake of water.